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Chorionic Structure of the Eggs of Five Laphriinae Species (Diptera: Asilidae) From Turkey

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ABSTRACT

The chorionic structure of the eggs of five Laphriinae species [*Andrenosoma serratum* Hermann, 1906, *Choerades fuliginosa* (Panzer, [1798]), *Choerades fulva* (Meigen, 1804), *Choerades loewi* Lehr, 1991, *Laphria aurea* (Fabricius, 1794)] were examined utilizing scanning electron microscopy (SEM). All the eggs which are examined species are dull brown in color. The egg shape is changed from ovoid (*C. fuliginosa*, *C. fulva,* and *L. aurea*) to cylindrical (in *A. serratum* and *C. loewi*). The chorion is composed of numerous polygonal cells except the eggs of *L. aurea*. The borders of the polygons are slightly elevated ridges of uneven lengths and more or less distinct in the species. The polygonal pattern is weak and ridges tend to become flattened in the micropylar area. Two micropylar openings exist in the all species and some of the male sperm tails can be seen in them. Aeropyles also are seen on the chorionic surface.

Key words: Diptera, Asilidae, Laphriinae, scanning electron microscopy, SEM, egg, chorion, micropyle, aeropyle.

INTRODUCTION

Egg morphology, size, shape, and chorionic structures have become taxonomically important in a wide variety of insect orders, such as Diptera, Lepidoptera and Hemiptera (Candan *et al.,* 2001, 2004a, b, 2005; Candan & Suludere, 1999 a, b; Suludere *et al.,* 1999, 2000; Javahery, 1994). The surface ornamentations of eggs by scanning electron microscopy (SEM) has been shown to allow identification of species (Musso, 1981; Salked, 1983, 1984; Lavigne & Bullington, 1984; Lawson & Lavigne, 1984; Castillo *et al.,* 1994; Suludere *et al.,* 2000; Hasbenli *et al.,* 2006).

Descriptions of asilid eggs was very rudimentary prior to the creation of the scanning electron microscope (Melin, 1923; Lavigne, 1963 a, b, 1964; Dennis & Lavigne, 1975). Only a few studies examining the surface structure of eggs of Asilidae with an SEM have been conducted thus far, however. While the chorions of many species of robber flies appear to be smooth (Scarbrough & Kuhar 1992), those of a number of species are definitely sculptured, a feature which is valuable for taxonomists seeking to separate closely related species. Based on SEM studies to date, sculpturing of the chorion seems to be widespread having been recorded as occurring in the sub-families Leptogastrinae, Asilinae, Dasypogoninae, Dioctriinae, Laphriinae, Stenopogoninae, and Trigonomiminae. The ridges form various shapes from circles to hexagons (Candan *et al.*, 2004 a, b; Castillo *et al*., 1994; Musso, 1981); in the Asilinae there are only scattered tubercles with no formal structure (Clements & Skidmore, 1998; Lawson & Lavigne 1984; Musso, 1981; Suludere *et al.,* 2000).

Candan *et al.* (2004a) compared SEM scans of the eggs of *Dioctria flavipennis* (Dioctriinae) with those of 14 asilid species from the mid-Atlantic region of North America, including seven species in the Laphriinae: Atomosinii: *Atomosia puela* (Wiedemann, 1828) and *Cerotainia albipilosa* Curran, 1930 and Laphriini: *Laphria divisor* (Banks, 1917), *L. flavicollis* Say, 1824, *L. ithypgi* McAtee, 1919, *L. sicula* McAtee, 1919 and *L. virginica* (Banks, 1917).

In this current study, the surface structure of eggs of five additional species of Laphriinae have been examined: *Andrenosoma serratum* Hermann, 1906 (Andrenosomini), *Choerades fuliginosa* (Panzer, [1798]), *C. fulva* (Meigen, 1804), *C. loewi* Lehr, 1991 and *Laphria aurea* (Fabricius, 1794) (Laphriinae: Laphriini) were examined in detail with the SEM.

MATERIAL AND METHODS

Adult females of *Andrenosoma serratum* were collected from Mersin (Mut, Çömelek village, Sason valley, 36°42'N, 33°41'E, 3 July 2006); those of *Choerades fuliginosa* from Mersin, (Çamlıyayla, Cehennemdere, 37°7'N, 34°31'E, 28 June 2007); those of *Choerades loewi* from Mersin (Çamlıyayla, Çalkalı Forest store, 37°10'N, 34°39'E, 1 July 2006); those of *Choerades fulva* from Antalya (Korkuteli, Karabayır Plateau, 36°57'N, 30°0'E, 11 July 2003); and those of *Laphria aurea* from Konya (Taşkent, Beyreli village, Gevne Valley, 36°51'N, 32°21'E, 6 July 2006) in Turkey.

Females of all species except *L. aurea* were placed in plastic jars where they deposited eggs singly on cotton batting. Eggs of *L. aurea* were obtained from the ovaries of a dried pinned specimen. In order to soften the abdomen, it was dissected and placed in 70 % ethanol. Then it was opened and the eggs were removed from abdomen gently. Developed eggs were cleaned, tissues were removed and the clean eggs were air dried after dehydration with ethanol. Eggs were prepared for SEM following methodology (Suludere, 1988). They were mounted with double-sided tape on SEM stubs, coated with gold in a Polaron SC 502 Sputter Coater, and examined with JEOL JSM 6060 Scanning Electron Microscope at 10-15 kV. Some measurements are reported as averages, others as ranges (Minimum-maximum values).

RESULTS

The eggs of all five species were dull brown in color. Egg separated into two major categories by shape: elongate-cylindirical and ovoid and by size (Table 1).

Table 1. The egg size of five species of Laphriinae.

Species	Ratio	Average (mm) Width x Length	Ranges (mm) Width	Ranges (mm) Length	Ratio Length/Width
Andrenosoma serratum Hermann, 1906	2.0 >	0.32x0.71	0.266-0.371	0.692-0.733	2.23
Choerades fuliginosa (Panzer, [1798])	1.5 <	0.46x0.52	0.423-0.486	0.488-0.556	1.14
Choerades fulva (Meigen, 1804)	1.5 <	0.46x0.61	0.453-0.475	0.584-0.634	1.32
Choerades loewi Lehr, 1991	2.0 >	0.25x0.55	0.229-0.286	0.487-0.573	2.21
Laphria aurea (Fabricius, 1794)	1.5 <	0.70x0.80	0.682-0.739	0.795-0.827	1.14

The chorionic ornamentation, location of the micropyle, and of the aeropylar structures are presented for each species below.

Andrenosomini

Andrenosoma serratum Hermann, 1906

Eggs of *Andrenosoma serratum* are elongate and cylindirical, and approximately 0.71 mm in length and 0.32 mm in width (Fig. 1a). The ratio of length to width is 2 >. The chorion is composed of numerous polygonal cells which are not easily distinguished (Fig 1b). The borders of the polygons are slightly elevated ridges of uneven lengths. Aeropyles are usually distributed near the micropylar area, are rarely seen on the remaining part of eggs (Fig. 1b, c). The polygonal pattern disappears near the micropylar area and where the pitted area begins (Fig. 1d). Two micropylar openings exist in the center of a somewhat circular non-pitted area (Fig. 1 d, e). Some of the male sperm tails can be seen in the micropylar openings (Fig. 1e). An eclosion line is absent on the eggs. The opposite end of egg is also covered with polygons, but this pattern is not easily observed (Fig. 1f).

Laphriini

***Choerades fuliginosa* (Panzer, [1798])**

Eggs of *Choerades fuliginosa* are ovoid, and approximately 0.52 mm in length and 0.46 mm in width (Fig. 2a). The ratio of length to width is 1.5 <. The chorion is composed of numerous polygonal cells which are mainly hexagonal or pentagonal,and rarely otherwise (Fig. 2b). The borders of polygons are composed of small tuberculated and pitted ridges raised above the exochorionic surface and of unequal lengths (Fig. 2c). Aeropyles are widely distributed on the egg surface (Fig 2c) They occur as one or two surface pores on the inter-ridge areas or aeropyles are lacking (2c). Polygonalpattern is weakly reached to the micropylar area which has two circular opening in the center (Fig. 2d). Some of the sperm tails can be seen within the micropylar openings (Fig 2e)**.** An eclosion line is absent on the eggs. The opposite end of micropylar area is also covered polygons like the remaining part of eggs (Fig. 2f).

***Choerades fulva* (Meigen, 1804)**

Eggs of *Choerades fulva* are ovoid, and approximately 0.61 mm in length and 0.46 mm in width (Fig. 3a). The ratio of length to width is 1.5 <. The chorion is composed of numerous polygonal cells which are mainly hexagonal or pentagonal, and rarely otherwise (Fig. 3b). The border of the polygons is composed of small tuberculated ridges raised from the exochorionic surface and of variable length (Fig. 3c) . Aeropyles are widely spread across the exochorionic surface, including within both the ridge and interridge areas (Fig. 3b, c). They usually occur as single surface pores on a flat circular area. Very rarely either two aeropyles are present in the same interridge area or none are present. The polygonal pattern is weak and ridges tend to become flattened in the micropylar area (Fig. 3d). Two circular micropyles are found in the center of each somewhat floral-like structure (Fig. 3d). Sperm tails can be seen within the micropyles (Fig. 3e). An eclosion line is absent on the eggs. The opposite end of egg is also covered with polygons (Fig. 3f).

***Choerades loewi* Lehr, 1991**

Eggs of *Choerades loewi* are elongate and cylindirical, and approximately 0.55 mm in length and 0.25 mm in width (Fig. 4a). The ratio of length to width is 2 >. The chorion is composed of numerous polygonal cells which are mainly hexagonal or pentagonal, and rarely otherwise (Fig. 4b). The border of each polygon is composed of solid ridges raised from exochorionic surface and of variable lengths. Aeropyles are spread across the exochorionic surface, including within both the ridge and interridge areas (4b, c). They usually appear as single surface pores on flat surfaces. Very rarely either two aeropyles are present in the same interridge area or none are present. The polygonal pattern is weak and the ridges become flattened in the micropylar area. Dual circular micropyles are found in the center of the somewhat floral-like structure (Fig. 4d). Sperm tails can be seen within some of the micropyles (Fig. 4e). An eclosion line is absent on the eggs. The opposite end of egg is also covered with polygons (Fig. 4f).

***Laphria aurea* (Fabricius, 1794)**

Eggs of *Laphria aurea* are ovoid, and approximately 0.8 mm in length and 0.7 mm in width (Fig. 5a). The ratio of length to width is 1.5 <. The exochorion is simple and smooth without erect exochorionic ridges or polygons (Fig. 5b). Under very high magnifications some aeropyles and many very small pores on the chorionic surface can be magnifications some aeropyles and many very small pores on the chorionic surface observed (Fig. 5c). The micropylar area is discernable because of the indentated margin and the lighter colporation (Figs. 5d, e). Two circular micropylar openings occur in the center while small tubercules and small irregular ridges make up the surface of the remaining part of micropylar area (Figs. 5d, e). An eclosion groove delineating the micropylar area is absent on these eggs. The opposite end of egg is fairly smooth (Fig. 5f).

DISCUSSION

The eggs of laphriine asilids vary both in size, shape, color and chorionic sculpturing. They range from elongate to oval (Melin, 1923; Candan *et al.*, 2004a).

Little is known of the eggs of *Andrenosoma*, The eggs of *Andrenosoma atra* are generally oval (800-900 long & 350-400 wide) (Musso, 1978). Musso (1981) stated that the chorions of the eggs of both *A. atra* and *A. bayardi* were rather thick, with a deep brownish red tinge. Additionally, they had a reticular structure, due to the presence of irregular juxtaposited polygons with high sinuous bulges. He noted that there was no other surface ornamentation and placed the *Andrenosoma* eggs into his “pigmented egg” group. As noted above, the eggs of *A. serratum* are elongate and cylindrical (0.71 mm in length and 0.32 mm in width) and the chorion is composed of numerous polygonal cells, which are not easily discernable, making them very similar in structure to those of *A. atra*.

According to Melin (1923), *Laphria* and *Choerades* eggs are firm and furnished with a facet-like covering. He stated that all *Laphria* (*L. ephippium, L. flava* and *C.*

marginata, C. gilva, and *L. gibbosa*) "have oval-shaped eggs"; however the profile of *L. ephippium* is more cylindrical than oval. Lavigne & Bullington (1984) noted that the eggs of *Laphria fernaldi* were oval and reddish brown and found that the eggs have chorionic sculpture similar to that described by Musso (1981) for *Andenosoma* eggs. All of the eggs of the three species of *Choerades* studied herein are covered with distinct polygons. While *C. fuliginosa* and *C. fulva* have ovoid eggs, the eggs of *Choerades loewi* are elongate and cylindrical in shape, similar to those of *L. ephippium*.

With SEM capabilities, it is possible to comment with more clarity on the chorionic structure of Laphriine eggs. Castillo *et al.* (1994) studied the Laphriine eggs of *Dissmeryngodes anticus* (Wiedemann 1828) and *Atomosia dasypus* (Wiedemann 1828). Eggs of *D. anticus* were hemispherical and the micropylar area was found to be confined to a single area; however no observable micropyles were noted. The chorions were composed of numerous subhexagonal subpentagonales cells. *A. dasypus* has a hemispherical egg, slightly sharpened towards the apical region where the micropylar area with two micropyles occurs.

Candan *et al.* (2004a) have previously reported on the eggs of 7 Laphriinae species. They noted that eggs of Laphriinae species they studied had distinct, complex polygon ridges with the exception of *Laphria ithypgi* which has a tuberculate pattern and low interconnecting ridges. *Laphria flavicollis*, *Cerotainia albipilosa* and *Atomosia puella* are composed of loosely organized hairlike or thicker digitate processes. The broad interridge areas are usually much shorter than surrounding ridges and covered by an erect process. The inter-ridge processes of eggs of *C. albipilosa* and *A. puella* are only slightly shorter than those that form ridges. The interridge areas are sometimes bare (*L. divisor*), especially near micropylar region (*L. virginica*), but most (*C. albipilosa*, *A. puella*, *L. flavicollis*, *L. sicula*, *L. ithypgi*, *L. virginica*) are covered with various processes, some of which are fused whereas others are thin and hairlike or thicker and digitate. Although, the examined 5 species, *A. serratum, C. fuliginosa, C. fulva,* and *C. loevi* have more or less distinct polygons, *L. aurea* does not exhibit a polygonal pattern or other distinct structure and is ovoid which is similar to most *Laphria* species.

Egg chorions have some modifications to facilitate gas exchange and save moisture. Oxygen intake and moisture are probably a significant factor in initiating the hatching of the egg. In some genera (*Laphria, Atomosia, Cerotainia, and Eudioctria*), aeropyles, which allow respiratory exchange of oxygen and carbon dioxide with a relatively small loss of water, are scattered on surface of a thick chorion. According to Hinton (1981) females in these genera usually drop their eggs randomly. In those genera which have a thin chorion, such as *Leptogaster, Psilonyx, Tipulogaster* and *Tolmerus*, eggs are deposited on or in vegetation to prevent moisture loss (Melin, 1923; Candan *et al.,* 2004a, b).

In most Laphriinae species, aeropyles are widespread across the exochorionic surface, including within both ridges and interridge areas as in *C. albipilosa, L. flavicollis*, *L. sicula*, *L. ithypgi* and *L. virginica* (Candan *et al.,* 2004a). Castillo *et al.* (1994) reported that *D. anticus* and *A. dasypus* lack aeropyles; however aeropyles were found on eggs of all examined species in this study. In *A. serratum,* aeropyles tend to be concentrated near the micropylar area. In the other species, *C. fuliginosa, C. fulva, C. loewi* and *L. aurea,* aeropyles are distributed across the egg surface among small chorionic pores, either singly or doubly on the interridge or ridge areas.

The micropylar area asilid eggs is usually smooth and flattened around the micropylar region; however *Dioctria flavipennis* has a distinct row of similar sized oval rings surrounding the micropylar region (Candan *et al.,* 2004a). In most of the Laphriinae species, the micropylar area is largely smooth with ridges becoming shorter and flattened toward the center (Candan *et al.,* 2004a). One or two micropylar openings are found in the center of micropylar area. Castillo *et al.* (1994) observed two micropyle openings in *A. dasypus* but none in *D. anticus.* Candan *et al.* (2004a) reported the presence of a single micropyle opening for five Laphriinae species (*C. albipilosa*, *A. puella*, *L. virginica* and *L. flavicollis*). In current study, the eggs of all examined species had two micropylar openings often with with sperm tails visible (See Figs. 1e-4e). Lawson & Lavigne (1984) reported the presence of sperm flagella in the micropylar opening of an egg of *Colepia abludo* as did Candan *et al.* (2004a) for *Holcocephala abdominalis* eggs.

Egg morphology may prove to be useful to elucidate taxonomic and possibly phylogenetic relationship among asilids; however a great deal more needs to be learned about the chorionic structure of Asilid eggs before such data will be useful.

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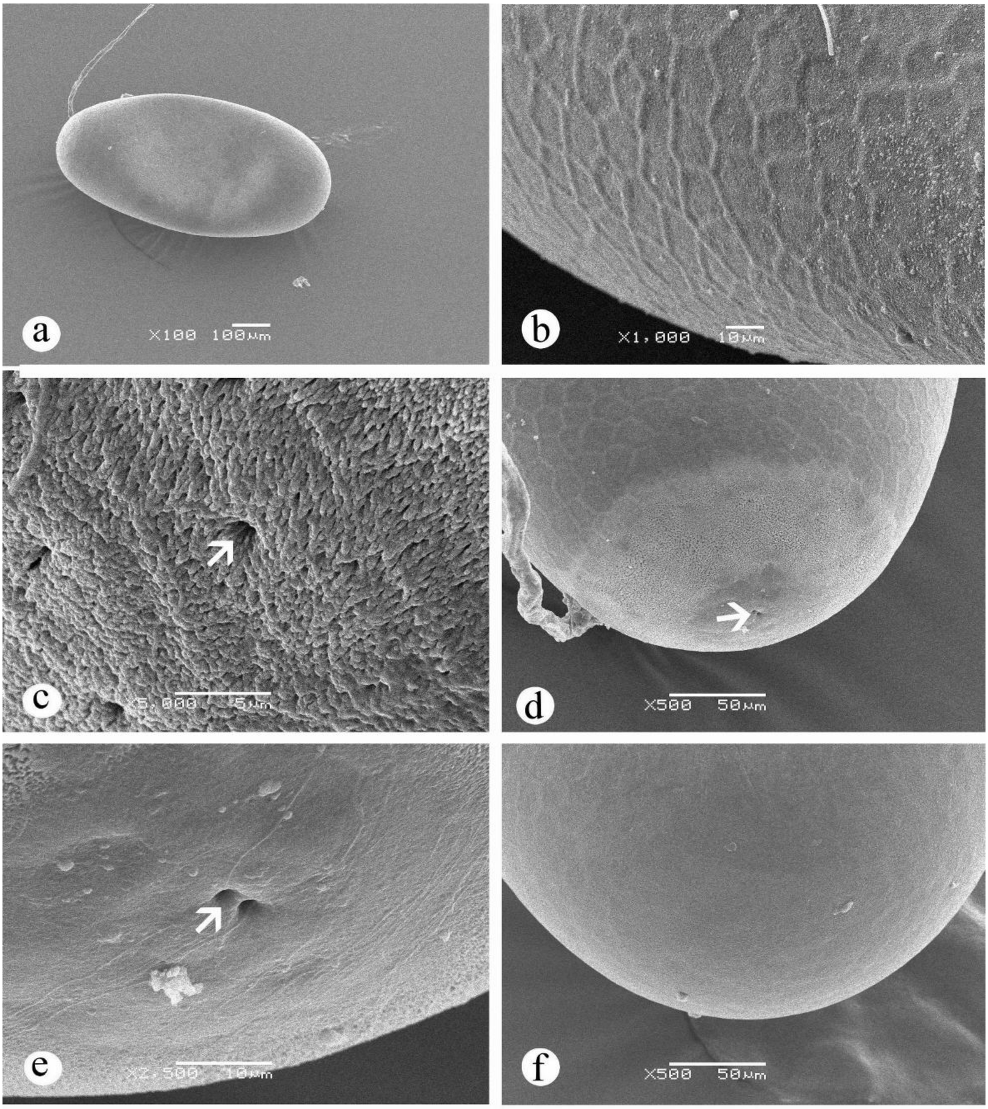

Fig. 1. SEM of the egg of *Andrenosoma serratum.* a. Egg morphology, side view, b. Polygons on the surface of exochorion, c. Aeropyles near the micropylar area (arrow), d. Micropylar region with two micropyles (arrow), e.Sperm tails in the micropylar openings (arrow), f.The opposite end of egg.

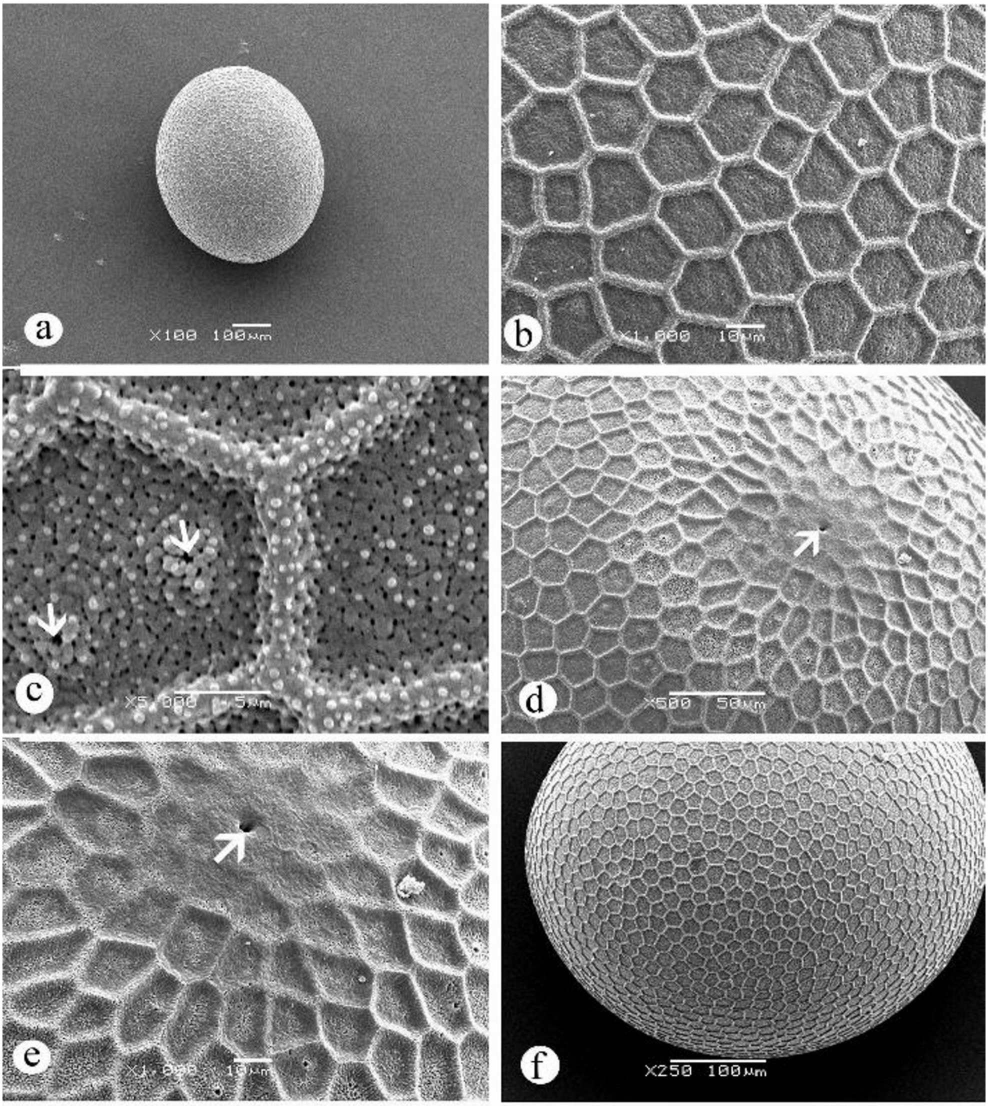

Fig. 2. SEM of the egg of *Choerades fuliginosa.* a. Egg morphology, side view, b. Polygons on the surface of exochorion, c. Aeropyles (arrows), d. Micropylar region with two micropyles (arrow), e. Sperm tails in the micropylar openings (arrow), f. The opposite end of egg *Choerades fulva* (Meigen, 1804)

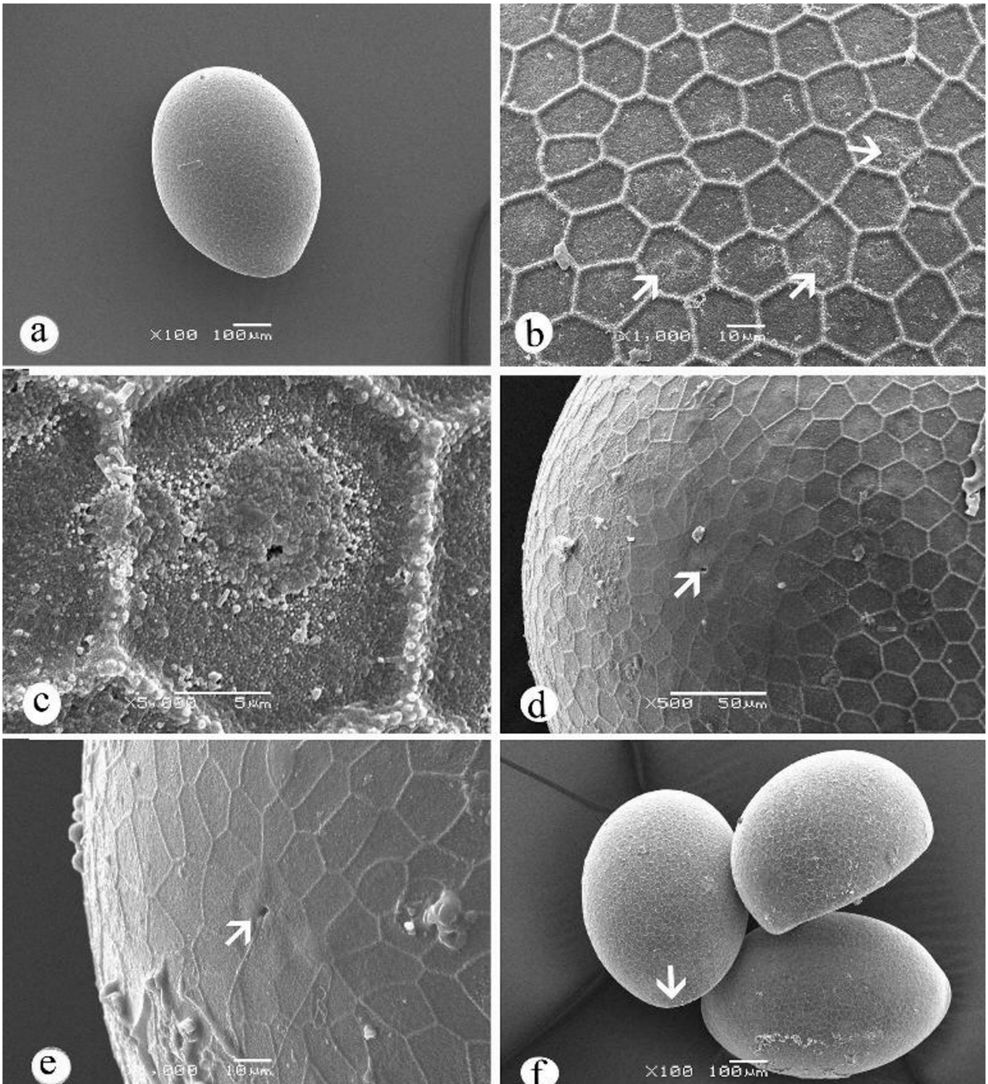

Fig. 3. SEM of the eggs of *Choerades fulva.* a. Egg morphology, side view, b. Polygons and aeropyles (arrows) on the surface of exochorion, c. Aeropyles (arrows), d. Micropylar region with two micropyles (arrow), e.Sperm tails in the micropylar openings (arrow), f. The opposite end of egg (arrow).

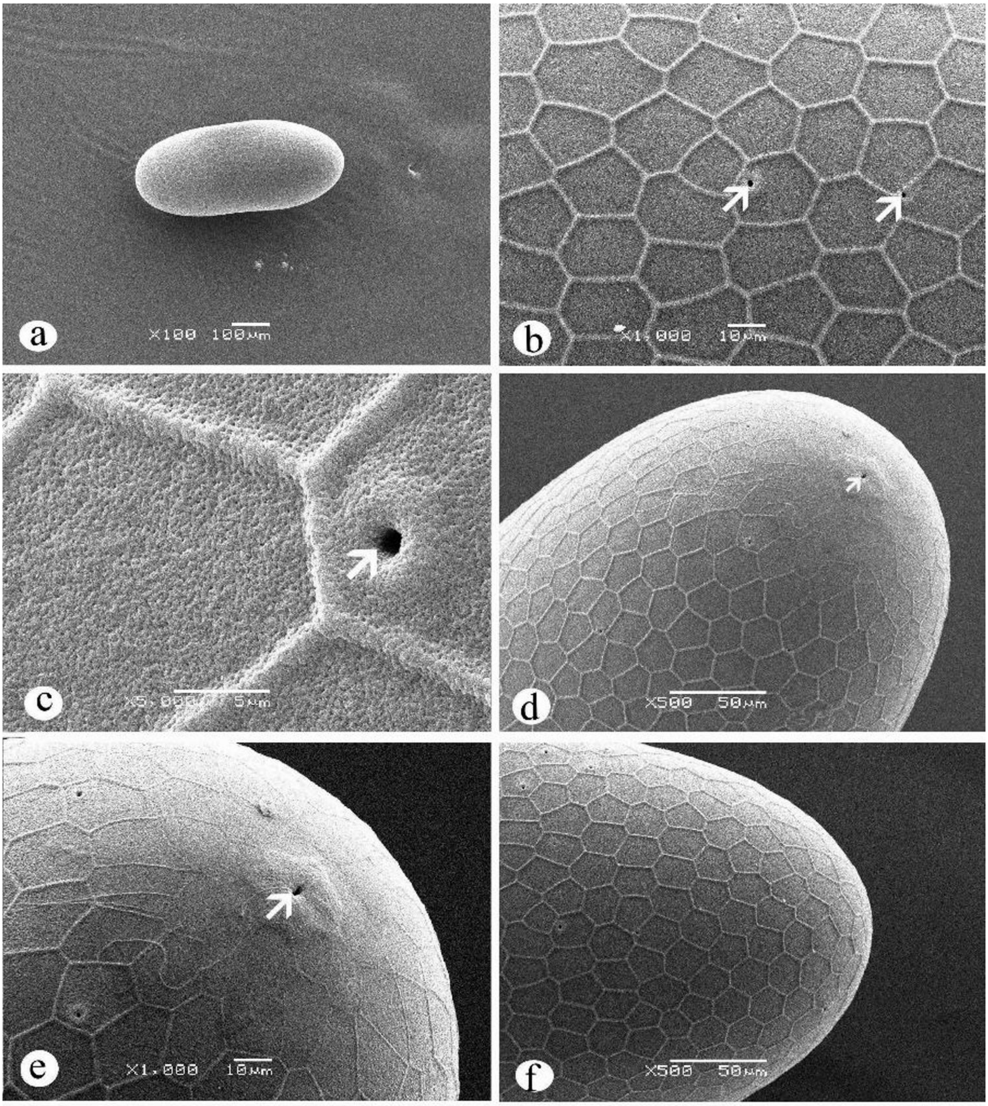

Fig. 4. SEM of the egg of *Choerades loewi.* a. Egg morphology, side view, b. Polygons and aeropyles (arrows) on the surface of exochorion, c. Aeropyle (arrow), d. Micropylar region with two micropyles (arrow), e.Sperm tail in the micropylar opening (arrow), f.The opposite end of egg.

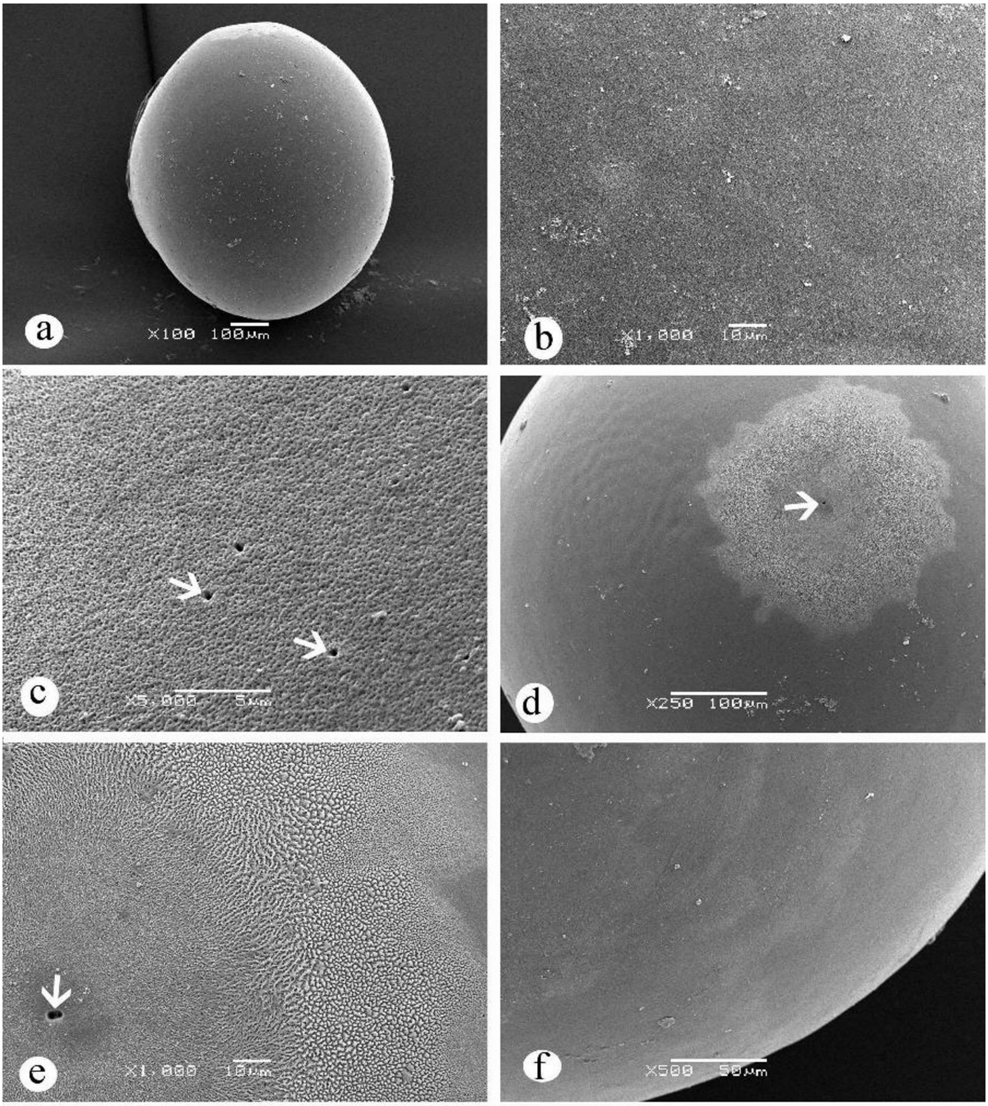

Fig. 5. SEM of the egg of *Laphria aurea.* a. Egg morphology, side view, b. Smooth surface of the chorion, c. Some aeropyles (arrows) among small pores, d. Micropylar area with indentated margin and distinct color pattern, with two micropyles (arrow), e. Two circular micropylar openings (arrow) and nearby small tubercules and small irregular ridges, f.The opposite end of egg.

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